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The Impact of Formal Finance on the Rural Economy of India

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and
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India's supply-led approach to agricultural credit paid off in nonfarm growth, employment, and rural wages. The impact of expanded credit on agricultural output has been modest, and the benefits of agricultural income exceed the costs of the program only if optimistic assumptions are made about repayment rates on farm credit.

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India has systematically pursued a supply-led approach to increasing agricultural credit. Its objectives have been to replace moneylenders, to relieve farmers of indebtedness, and to achieve higher levels of agricultural credit, investment, and output.

India's success in replacing moneylenders has been outstanding. Between 1951 and 1971 their share of rural credit appears to have dropped from more than 80 percent to 36 percent. (It may have dropped to as low as 16 percent by 1981, but that estimate is disputed.)

Still, institutional credit is far from reaching all farmers. Only about a quarter of cultivators borrow, and no more than 2 percent take out long-term loans. Most small farmers have little access to credit, and long-term credit goes mostly to large farmers.

Overall, farm debt has probably not increased sharply in real terms, as formal credit has primarily substituted for credit from other sources. Moreover, with the rapid growth of commercial banks in the 1970s, the system mobilized more deposits than it lent in rural areas in 1981. Of course, enhanced deposit services are a useful service for the rural population, but one must ask what has been the impact of heavy rural credit and better financial services on agricultural investment, production, and rural incomes.

Binswanger and Khandker's econometric results suggest that the rapid expansion of commercial banks in rural areas has had a substantially positive effect on rural nonfarm employment and output. The availability of better banking facilities appears to have overcome one of the obstacles to locating nonfarm activities in rural areas.

Expanded rural finance has had less of an effect on output and employment in agriculture than in the nonfarm sector. The effect on crop output has not been great, despite the fact that credit to agriculture has greatly increased the use of fertilizer and private investment in machines and livestock. There has been more impact on inputs than on output, so the additional capital investment has been more important in substituting for agricultural labor than in increasing crop output.

But overall, rural credit and expansion of the rural financial system have had a positive effect on rural wages. Creating nonfarm jobs has apparently added more to total employment than the substitution of capital for labor has subtracted it in agriculture. So, wages have risen even for agricultural workers, albeit modestly.

The supply-led approach to agricultural credit that has been pursued for three decades has clearly benefited current borrowers and farm households formerly indebted to moneylenders. It has also spurred fertilizer use and investment in agriculture. It has been less successful in generating viable institutions — and has failed to generate agricultural employment.

The policy's costs to India's government have been high as portfolio losses associated with poor repayment ultimately have to be borne by the government or one of its institutions under optimistic assumptions. The benefits of the agricultural income are at best no more than 13 percent higher than the cost to the government of the extra agricultural credit. If assumptions about the cost of supplying the credit and about repayment rates are less optimistic, the social costs — and the costs to the government of providing the credit — would have exceeded the benefits in agricultural income.

The expansion of commercial banks to rural areas paid off in nonfarm growth, employment, and rural wages. The question is: Could these benefits have been achieved without imposing agricultural credit targets on the commercial banks and credit cooperatives? Or did the commercial banks expand only because they were forced to lend to agriculture? The authors could not answer these questions with the data at hand.

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INTRODUCTION

Expanding the availability of agricultural credit has been widely used in developing countries as a policy to accelerate agricultural and rural development. In many countries credit and the credit institutions were heavily subsidized. Recent research has focused on the impact of these policies on the credit institutions and farmer repayment behavior (for a summary see Braverman and Guash, 1984, or Feder et al, 1989), and comes to the conclusion that the directed programs have rarely created viable credit institutions and that credit subsidies have undermined repayment morale of farmers.

However, the agricultural credit programs could still be beneficial from a societal point of view if they overcome liquidity problems associated with highly imperfect rural credit markets. High return investments could result which were previously infeasible. The effect on rural output could be so large that the benefits exceed the cost of the credit program to government or to society.

Few studies exist that evaluate the benefits and costs of credit programs in this manner. While many World Bank project evaluations suggest that benefit-cost ratios of credit programs are usually high, the approach taken in these studies is fundamentally flawed by the fact that the studies assume that money is not fungible.[1/] A recent evaluation of the

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1/ The standard techniques used by the World Bank estimates the benefit cost ratio of the farmer's project which is to be financed by credit, and then assigns to the credit program 100 percent of these benefits. It thereby assumes a one-to-one correspondence between credit advanced by a specific lender and the project. The possibility that the lender's credit could replace credit from other formal and informal lenders, or substitute for self-finance, is not admitted. This analysis, therefore, is likely to exaggerate

Integrated Rural Development Program in India (Pulley 1989) also focuses on output and income effects of investments financed of credit in beneficiary households. Formal post-evaluations of credit programs such as those carried out in India by the National Bank for Agriculture and Rural Development (1981 et sequa) are more sophisticated. Their approach is also discussed in David and Meyer, 1980. These studies compare the output and costs of farms that receive credit under a specific program with farms that did not. A more sophisticated version of cross-sectional comparison are production function studies (for an early review see David and Meyer, 1980). All studies based on such cross-sectional comparisons will overestimate the benefits of credit if credit goes selectively to better farmers, or to farmers with better endowments in terms of land, machinery and liquid capital. Said otherwise, the cross-sectional estimates are likely to suffer from selectivity bias.

An approach that can overcome both the problems of fungibility and of selectivity is supply function analysis, where credit enters as an independent variable in the supply function. However, credit can favor one crop at the expense of others. Applying the techniques to an individual crop could therefore over- or underestimate the supply effects, if effects on other crops are not taken into account. A simple way to circumvent this problem is to estimate the impact of credit expansion on aggregate output. This is the approach to the estimation of benefits taken in this paper. Other major econometric problems associated with

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benefit-cost ratios. Underestimation of the benefit cost ratio is also possible in the less likely event that additional credit may induce more self-finance, because it eliminates a credit constraint for a lumpy investment and thereby induces more, rather than less, self finance.

this approach are discussed in Section 3. We are not aware of other studies that have used this approach.

In addition to the impact on output, interest also focuses on how additional credit affects investment into fixed capital and the use of variable factors such as fertilizer and labor. Gandhi (1986), for example, estimates agricultural investment equations using aggregate time series data for India with credit as an exogenous variable. His study assumes that credit demand is equal to credit supply and that, therefore, credit use is exogenous. He assumes away the possible joint dependence of investment demand and credit use, a problem addressed in Section 3. Schluter, 1974, estimated input demand functions for labor, modern varieties, fertilizer, crop area, animal and machine power with respect to credit, using cross section data for Surat district in India. He did not account for possible simultaneity or selectivity bias. Another cross-section study in the Philippines estimated the impact of credit use on allocative efficiency (Mandac and Herdt, 1978).

Finally, the expansion of rural financial institutions may reduce liquidity constraints in the rural nonfarm sectors. And credit to agriculture may have secondary spillover effects on the nonfarm economy via input, labor and output linkages (Haggblade and Hazell, 1989). We are not aware of any studies investigating these second-round effects of rural finance.

During the 1970s, India's rural financial system expanded very rapidly, providing an excellent opportunity for a quantitative study. After their nationalization in 1969, the major commercial banks were directed to expand their rural branch networks and intensify their lending to agriculture. The traditional cooperative institutions expanded credit to agriculture rapidly as well. The first purpose of this paper is to quantitatively assess the impact of this expansion on agriculture and the rural economy. We estimate the impacts of additional credit on aggregate crop output and on agricultural investments, fertilizer demand and labor use. In addition, we estimate the credit impact on rural nonfarm employment and rural wages.

The expansion of agricultural credit in India has been subsidized in several ways. Firstly, there is a cross subsidy of interest rates financed from nonagricultural sectors and from government resources. Agricultural rates are lower than commercial and industrial rates. Secondly, commercial banks cover the cost of their agricultural loan administration from profit arising from other operations and the government subsidizes the operational cost of the cooperative credit system. Moreover, relatively high levels of overdues and bad loans build up a liability that must eventually be made good by the government.

Using the estimated quantitative impacts of credit expansion and agricultural output, the second purpose of this paper is to attempt to estimate a benefit-cost ratio for these explicit and implicit subsidies.

Section 2 sets the stage by describing the general approach that India has used to develop agricultural credit, and the extent to which farmers use credit from formal and informal sources. It then describes in more detail the formal credit institutions and how they have grown in the 1970s and early 1980s, the period for which the econometric analysis is carried out.

Section 3 discusses the analytical framework and econometric techniques to estimate the impact of credit expansion. Data and variables used in the analysis are also discussed. The impact of credit expansion on agriculture and the rural economy is discussed in Section 4. In Section 5, a benefit-cost analysis of the subsidies is attempted, and the conclusions of the paper are summarized in Section 6.

2. EVOLUTION OF THE RURAL FINANCIAL SYSTEM

For over a hundred years, India has followed a deliberate policy to build and strengthen formal credit institutions. Initially, under British colonial rule, the civil courts strengthened the position of moneylenders. However, in the late 1800s moneylenders appeared to widely abuse their position, taking advantage of farmer debts to take over farmers' lands. In 1875, near Poona in today's Maharastra, rioting farmers evicted moneylenders from their villages (Walker and Ryan, 1990).

Following the riots, legislation was passed to curb the power of lenders and protect farmers' land. In the early 1900s, the first public sector credit societies were established, the primary agricultural cooperative credit societies (PACs). Shortly thereafter, the state land mortgage banks were founded, which later became the land development banks (LDBs). In 1935, formal recognition of the importance of agricultural lending was recognized with the establishment of the Reserve Bank of India, with a separate agricultural credit department.

After independence, the All-India Rural Investment Survey found that less than nine percent of farmers' cash borrowing in 1951-52 was from the formal sector (see Table 1). The share of the cooperative sector was only three percent. Moneylenders still provided about 83 percent of cash loans. Broader access to institutional credit became the guiding principle. In 1969, the large commercial banks were nationalized, and the Reserve Bank of India established minimum guidelines on the share of agricultural lending and the number of rural bank branches. The regional rural banks were instituted in 1975 to cater to poor households with limited access to commercial banks. And the National Bank for Agriculture and Rural Development (NABARD) was created for the refinancing of agricultural credit.

Table 1 shows how successful the supply leading approach had been by the beginning of the 1970s in displacing moneylenders from the rural credit system. By 1971, the institutional sources provided nearly 32 percent of all cash credit. Debt from moneylenders had decreased to 36 percent of the borrowings, and other sources such as

Table 1:

CAPITAL STOCKS AND DEBTS OF CULTIVATORS IN INDIA, 1951-1971 AS ESTIMATED BY THE ALL-INDIA DEBT AND INVESTMENT SURVEY a/
(rupees per cultivating household)

	1951	1961	1971
Total capital stock			
Current prices	5356	6609	14624
1971 prices b/	12935	12636	14624
Total cash debt			
Current prices	316	473	605
1971 prices b/	763	904	605
Cash debt to equity ratio (percent)	5.9	7.1	4.1
Percentage of cultivating households with cash debt			43.0
Proportion of cash debt from institutional sources c/	8.7	18.4	31.6
From the government			7.1
From cooperative societies or banks	3.0		22.0
From commercial banks			2.4
Proportion of cash debt from moneylenders d/	82.9	61.9	36.1
Proportion of cash debt from other sources	8.4	19.7	32.3
From traders and commission agents		7.1	8.4
From relatives and friends		5.2	13.1
From landlords			8.1
From others		6.5	2.7

a/ Data for the All-India Debt and Investment Surveys of 1981-88 appear to seriously underestimate debt of cultivators and is therefore not shown.

b/ Deflator for 1951 and 1961 calculated from R.N. Lal, 1977. Capital Formation and its Financing in India. Bombay: Allied Publishers, 151-52.

c/ Institutional sources include the government, cooperatives, commercial banks, and insurance and provident funds.

d/ Moneylenders include professional and agricultural moneylenders.

Source: All India Debt and Investment Surveys, 1951, 1961, 1971.

traders, landlords, and relatives and friends had increased their share of debt to about 32 percent. According to the All-India Debt and Investment Survey of 1981/82, the expansion of institutional lenders not only further reduced moneylenders to a share of 16 percent of the market, but also reduced the share of lending from traders, relatives and friends, and from landlords.[2/] It is therefore clear that any analysis that ignores the substitution of informal credit by formal credit programs will overestimate the benefits of those programs.

Until 1971, despite the large effort to increase institutional lending in rural areas, the growth in the agricultural capital stock per farm was not impressive. Between 1951 and 1971 the capital stock rose by a mere 18.5 percent--at less than one percent per year. Debt equity ratios, which were at the low level of about six percent, rose slightly but declined again to four percent in 1971.

During the 1970s credit outstanding to agriculture grew rapidly. The aggregate data are shown in Table 2. In 1972/73 (the first year for which commercial bank data are available), total credit outstanding to agriculture from all formal sector sources was Rs 21,697 million, which rose more than fourfold in nominal terms to Rs 87,978 million. Using the implicit GDP deflator for agricultural production, it rose to Rs 46,549 million, a 115 percent real increase during a decade.

2/ The data of the All-India Debt and Investment Survey of 1981/82 appear to seriously underestimate debt of cultivators and is, therefore, not further used. For a discussion see Bell, 1990.

Table 2:

THE RURAL BANKING SYSTEM AT A GLANCE, 1980/81
(millions of rupees)

	Commercial banks	Primary agricultural societies	Land development banks b/
Number of rural and semi-urban and branch offices	26146 (405)	94484 (-42)	2292 (75)
Total deposits mobilized	146290 (102)	2910 a/ (362)	360 (148)
Credit outstanding to agriculture	28770 (1500)	26210 (239)	26830 (206)
Total rural credit outstanding	72350 c/ n.a.	26210 (239)	26830 (206)
Credit advanced in rural and semi-urban branches	77630 (68)	17690 (228)	5980 (108)
Of which advanced to agriculture	n.a.	17690 (228)	5980 (108)

Note: Figures in parentheses are the percentage changes since 1969/70.

a/ Central cooperative banks, of which there were 337 in June of 1981, mobilized 24230 million rupees of deposits in the year 1980/81, a growth of 535% over June 1970. These rapidly growing deposits come from both rural and semi-urban areas, as the central cooperative bank offices are usually located in cities and in the rural towns. It is not possible to separate out rural deposits and semi-urban deposits. The deposits of the central cooperative banks and of the (urban) state cooperative banks are the major source of funds for the cooperative system, including the primary agricultural cooperative credit societies and the land development banks.

b/ Total for land development bank branches and primary land development banks.

c/ Total credit outstanding of commercial banks includes credit outstanding to activities other than agriculture and food processing.

How did the different components of the formal system develop over the decade of the 70s? Table 2 shows the structure of rural financial intermediation in 1980/81, with the exception of the regional rural banks.[3/] The Primary Agricultural Credit Societies (PACs) are specialized rural credit institutions based in individual villages or groups of villages. They have the most developed network, with nearly 95,000 societies, and are present in nearly all villages of India. In 1981/82, 21 percent of cultivators borrowed from PACs (Rath, 1987). During the 1970s, many dormant or illiquid societies were dissolved or merged into larger societies, and therefore, the number of societies has declined by about 42 percent. The PACs mobilize little resources of their own and their credit outstanding exceeds their deposit mobilization by a factor of nearly ten. Instead, they borrow from central and state primary cooperative banks, which together have nearly 9,000 urban and semi-urban branches where they mobilize deposits. The state cooperative banks, in turn, borrow or refinance from NABARD to cover the need of the system in excess of its deposit mobilization in rural and urban areas. Because the PACs lend primarily for short-term purposes, their annual lending is about two-thirds of their total portfolio outstanding. The PAC system lost about Rs 170 million during the year, although these losses may not fully account for unrecoverable loans.

Land development banks are cooperative institutions that lend primarily for long-term purposes. In some states, the land development banks lend to farmers through

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3/ The regional rural banks, which lend primarily to the poor, were left out of the analytical parts of the paper because time series data did not exist for a sufficiently long period. For an evaluation of poverty-oriented lending in India during the 1980's, see Pulley (1989).

branches of the central land development bank (the unitary system). In other states, primary land development banks are independent credit societies and are federated at the state level. The typical land development bank or bank branch serves a wider area than a village, such as a district or thesil (a subdivision of a district). In 1981, only about 0.6 percent of cultivators (landholdings) received a term loan from a land development bank (Rath, 1987). In 1980/81 annual lending was less than a fourth of the total volume of loans outstanding. Less than two percent of the loans outstanding were financed from deposit mobilization. The state land development banks raise resources by issuing debentures, which are held by NABARD, the Government of India, the Life Insurance Company of India, and various other financial intermediaries. The central land development banks made a small profit of Rs 170 million while the states with primary land development banks lost about the same amount, so that the system as a whole lost about Rs ten million.

The commercial banks have about 26,000 branches and have been the fastest growing segment of the rural financial system. Nevertheless, in 1981, less than three percent of cultivators had an account with commercial banks and only 0.6 percent of cultivators had a long-term loan outstanding (Rath, 1987). In sharp contrast to the PACs and the land development banks, commercial banks use rural branches heavily for deposit mobilization; deposits amount to more than twice their total loans (agricultural and nonagricultural) in rural areas. Nevertheless, rural loans outstanding of commercial banks are Rs 72 billion while those of the PACs and land development banks amount to only about Rs 26 billion each. In terms of total credit outstanding to agriculture (that is, excluding loans of the commercial

banks to nonagricultural enterprises) the three parts of the rural financial system were about equal in 1980/81, with Rs 26 to 29 billion of outstanding loans. Much of the rural nonfarm lending of commercial banks is not necessarily related to agriculture, as food processing loans are less than five percent of the total loan portfolio of rural and semi-urban branches. Loans of the commercial banks are primarily short-term loans, as can be seen by the fact that credit advanced in 1980/81 was slightly larger than credit outstanding.

3. THE ECONOMETRIC FRAMEWORK AND THE DATA

When the farmer faces a credit constraint, additional credit supply can raise input use, investment, and hence output. This is the liquidity effect of credit. But credit has another role to play. In most developing countries where agriculture still remains a risky activity, better credit facilities can help farmers smooth out consumption and, therefore, increase the willingness of risk-averse farmers to take risks and make agricultural investments. This is the consumption smoothing effect of credit. Thus, better rural credit markets may lead to a higher volume of agricultural output and consequently employment and wages than would be attainable with a less developed or less efficient credit system.

The Econometric Framework

Several econometric problems arise. The first is the absence of reliable time series data on informal credit. As shown in Table 1, the informal credit sector, (professional

moneylenders, commission agents, traders, relatives and friends) continued to play an important role in rural India at the beginning of the 1970s when our econometric analysis starts. During the 1970s and early 1980s, the importance of these lenders declined. However, time series data on informal credit do not exist. Can we still estimate the contribution of formal credit? If expansion of formal credit causes a reduction in informal credit, a regression of output on formal credit will measure the effect of expansion of credit net of the effect of reduced informal credit. This assumption may be quite reasonable: If the terms of credit in the formal system are better than from informal lenders, farmers would prefer to first satisfy their credit demand from formal lending agencies. If the formal lenders fail to satisfy their demand for credit (or they know that they would refuse credit) then farmers would approach the informal lenders at a higher rate of interest. This suggests that the absence of information regarding informal loans may not affect the estimates of the effects of institutional credit (Feder and others, 1988).

The second econometric problem is the joint dependence of output credit demand and credit supply on other variables such as the weather, prices, or technology. Credit advanced by formal lending agencies is an outcome of both the supply of and demand for formal credit. The amount of formal credit available to the farmer, his credit ration, enters into his decision to make investments, and to finance and use variable inputs such as fertilizer and labor. There is, therefore, a joint dependence between the observed level of

credit used, aggregate output, investment and input use.[4/] We, therefore, need to disentangle the supply of formal credit from its demand.

A two-stage procedure can solve this identification problem. Since financial institutions decide how many branches or offices a district should have, the number of offices is exogenous to farmer demand and can be used as an exogenous variable identifying the credit supply equation. We therefore, first estimate a credit equation with credit advanced as the dependent variable with, among others, the number of branches of financial institutions as explanatory variables. From this equation we predict the supply of credit to each district by formal financial intermediaries. Predicted supply is uncorrelated with the residuals of the

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4/ Credit can enter into the output supply, and hence input demand and investment or wage functions, if credit is a binding constraint in a rural household's input-output decisionmaking. Assume that a farmer maximizes output function,

$$Q = K^{\alpha}X^{\beta} \qquad \text{(i)}$$

subject to a liquidity constraint,

$$rX = \delta \qquad \text{(ii)}$$

where Q is crop output, K is fixed capital (such as livestock and irrigation pumps), r is the price of variable inputs X (such as labor and fertilizer), δ is the total credit available to purchase variable inputs; and equation (i) is the familiar Cobb-Douglas production function. By simple manipulation, one can derive the input demand equation as

$$x^{c} = r^{-1\delta} \qquad \text{(iii)}$$

and the output supply equation is

$$Q^{c} = K^{\delta}r^{\beta}\delta^{\beta} \qquad \text{(iv)}$$

where X^{c} and Q^{c} are, respectively, credit-constrained level of input use and crop output. If competitive labor market exists and equilibrium condition is satisfied, one can also show agricultural wage as a function of credit ration available to the farmers.

aggregate output supply, investment and input use equations, and is, therefore, used in the second stage estimation of these latter equations.

The third econometric problem arises because formal agriculture lending is not exogenously given or randomly distributed across space. As discussed at length, in Binswanger, Khandker, and Rosenzweig (1988), both the farmers and financial institutions are influenced by agricultural opportunities implied in the agroclimatic endowments of a district. That means, the lending agencies will lend more in areas where agricultural opportunities are better, risk is lower, and hence, chances for loan recovery are higher (Binswanger and Rosenzweig, 1986). An unobserved variable problem thus arises for the econometric estimation and is associated with unmeasured or unmeasurable district characteristics. This problem can be overcome by the use of district-level panel data.

The system of equations to be estimated with the district-level time-series data are the following:

(1) $ICr_{jt} = ICr(X_{jt}, Z_{jt}, \mu_{jt}, \delta_j)$

(2) $Q_{jt} = Q_{jt}(X_{jt}, ICr_{jt}, \mu_{jt}, \delta_j)$

(3) $INP_{jt} = INp_{jt}(X_{jt}, ICr_{jt}, \mu_{jt}, \delta_j)$

(4) $INv_{jt} = INv_{jt}(X_{jt}, ICr_{jt}, INv_{j(t-1)}, \mu_{jt}, \delta_j)$

(5) $WAGE_{jt} = WAGE_{jt}(X_{jt}, ICr_{jt}, \mu_{jt}, \delta j)$

where equation (1) is the prediction equation for institutional credit advanced to the rural sector by the formal lenders; (2) is the output supply equation; (3) is the input demand equation; (4) is the investment equation; and (5) is the wage equation. ICr stands for institutional credit advanced; X is a vector of exogenous explanatory variables (including the output and input prices, government infrastructure, interaction terms between year and agroclimatic endowments, the rate of interest); Z is a vector of the number of formal lending agencies; Q is aggregate crop output; INp is the level of input (fertilizer and employment) used; INv stands for investment in pumps, draft animals, milk animals, and small stocks; WAGE is daily wage of agricultural workers; μ is vector of observable district-specific permanent characteristics; δ is district-specific unobservable characteristics influencing all dependent variables; j stands for district and t stands for time. The interaction terms between year (t) and agroclimates (μ_j) allow for a district-specific time trend which, among other factors, allows for district-specific rate of technical change.

The simultaneity problem arising out of the response of both government and farmers to the heterogenous district endowments can be overcome by the use of panel data with either the fixed or random effects technique. If the unobserved endowments are time-invariant and specific to each district, then a fixed effects procedure is appropriate. The random effects procedure accounts for the existence of both time-invariant and time-varying error components. The random effects procedure, however, ignores any correlation between the persistent errors (unobservable endowment effects) and time-varying observed variables.

We use Hausman-Wu specification test to determine whether the fixed or random effects model is appropriate for the given data and present results accordingly.

Data and Variable Description

The data used in this paper are drawn from 85 districts of India for 1972/73 to 1980/81. A more complete discussion of the data can be found in Binswanger et al, 1988. The number of observations varies depending on the data available for each dependent variable. Thus, 765 observations (85 districts for nine years) are used for the output supply and wage equations, 738 (82 districts for nine years) observations for the fertilizer equation, 228 (76 districts for three years) observations for the investment equations, and only 170 (85 districts for two years) observations for the farm and nonfarm employment equations. The investment data are computed from livestock censuses of 1966, 1972, 1976 and 1982, while fertilizer, crop output and wage data are from yearly fertilizer, wage and agricultural statistics published by the Ministry of Agriculture of India. Crop output is the aggregate index of 17 major crops using 1965/76 as the base year. Fertilizer is measured in nutrient tons of nitrogen, phosphate and potash. The wage rate is the daily wage rate of agricultural field workers. The investment variables are the net additions over each census interval to the stock of draft animals (male bullocks and male buffalos), milk animals (female bullocks and female buffalos), small stocks (sheep and goats) and pumps (both diesel and electric).[5/] Employment data, drawn from the population censuses of 1970 and 1980, are comparable

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5/ A second-stage equation for tractors could not be estimated because none of the explanatory variables has a significant effect on the tractors investment. Thus, the tractor variable was dropped.

with agricultural census years of 1971 and 1981. Agricultural employment is the number of persons who were employed in farm activities for at least 183 man-days in one of the census years. A similar definition is used for nonfarm employment.

The data for the commercial banks and the central commercial banks are published by the Reserve Bank of India in Banking Statistics. NABARD has kindly provided unpublished data on the PACs and the land development banks, which were collected by sending questionnaires to the state headquarters of these institutions.[6/] Note that the central commercial banks primarily advance credit to agriculture by lending to the PACs and the land development banks. Thus, rural credit, in this paper, is defined as the amount of institutional credit advanced to the rural sector by the commercial banks and the credit advanced to agriculture by the PACs and the land development banks. Total rural credit thus reflects the agricultural credit advanced by the PACs, land development banks, commercial banks, and nonagricultural rural credit advanced by the commercial banks. A pure agricultural credit variable cannot be constructed because district-level data on agricultural credit advanced by commercial banks do not exist. However, we also report the effects of agricultural credit advanced by the cooperative sector (PACs and land development banks) to compare with those of total rural credit advanced by the whole banking system (including the commercial banks). The mean and standard deviation of the variables involved in this paper are presented in Table 3.

6/ Thanks to Dr. Gadgil of NABARD who has kindly opened the database and personally organized the assembly of the unpublished banking data. This paper would not have been feasible without his kind help in collecting the banking data.

Table 3:

DESCRIPTIVE STATISTICS

Variable	Number of observations	Mean	Standard deviation
Dependent Variable			
Aggregate crop output index	765	1.338	1.168
Fertilizer consumption, nutrient tons/10 sq km	738	23.784	30.997
Net investment in draft animals, number/10 sq km	228	6.755	17.102
Net investment in milk animals, number/10 sq km	228	17.974	27.691
Net investment in small stocks, number/10 sq km	228	5.948	15.426
Net investment in pumps, number/10 sq km	228	1.645	2.034
Credit advanced to rural sector, '000 Rs./10 sq km	765	283.991	421.445
Cooperative credit advanced to agriculture	765	93.615	203.583
Agricultural real wage, Rs./manday	765	5.294	2.165
Agricultural employment, persons/10 sq km	170	235.492	196.889
Nonagricultural employment, persons/10 sq km	170	153.989	206.158
Independent Variable			
Aggregate real crop price index	765	0.851	0.328
Real price of fertilizer	765	3.459	0.493
Annual urban wage, real	765	4373.277	1406.924
Canal irrigation, '000 ha/10 sq km	765	0.068	0.101
Number of regulated markets/10 sq km	765	0.019	0.025
Number of villages with primary schools/10 sq km	765	1.289	0.663
Number of villages with electricity/10 sq km	765	0.976	0.865
Total road length, km/10 sq km	765	5.369	4.986
Number of rural and semi-urban branches of commercial banks/10 sq km	765	0.101	0.132
Number of cooperative bank branches/10 sq km	765	0.031	0.026
Number of agricultural cooperative societies/10 sq km	765	0.436	0.277
Number of land development banks/10 sq km	765	0.010	0.006
Annual rainfall, mm	765	1120.059	964.609
Soil moisture capacity index	85	2.349	1.01
Length of rainy season, months	85	3.653	1.368
Excess rainy months, number	85	1.236	1.394
Number of cold months	85	0.935	1.313
Percentage of area liable to flooding	85	1.389	3.532
Percentage of area potential for irrigation	85	30.001	31.909

The aggregate real crop price index is derived by dividing an index of aggregate crop price in each district (based on the international crop prices) by the consumer price index for rural workers using 1975/76 as the base year. Seventeen major crops were included in these indices and with base year 1975. The real fertilizer price is the price per nutrient ton of nitrogen, phosphorus and potassium at the rail head, which is set uniformly for the country. Canal irrigation is the area which was irrigated in each year by canals, which are largely built by the government. Regulated markets do not include all rural markets but only those where the government provides market infrastructure and regulates all trade through a supervised auction system. The government does not regulate the market price but may enter as a purchaser in order to prevent market prices from falling below its support price. Regulated markets are a government investment and intervention program to assist the farm sector in marketing. Road length includes all nonurban roads irrespective of the government entity that built and maintains it (central, state, district, and power and water district).

Agroclimatic endowments are measured by the following variables: rainfall is measured in millimeters per year. The length of the rainy season is defined as the number of months with a moisture-availability index greater than 0.33.[7/] Excess rainy months is the number of months with a moisture-availability index greater than one (Hargraves and others, 1985). Soil moisture capacity measures the size of the water reservoir a soil can hold. For

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7/ The moisture-availability index is a relative measure of the precipitation available for supplying moisture requirement with respect to evapo-transpiration. It is the ratio of the dependable precipitation to potential evapo-transpiration. Dependable precipitation is the assured rainfall at a predetermined probability level, usually 75 percent (Hargraves and others, 1985).

a given rainfall a higher soil moisture capacity means that a crop can withstand a longer dry spell. In addition, where soil moisture capacity is very high, a full moisture reservoir in the soil may be able to support several months of a crop cycle without additional rainfall or irrigation. For given annual rainfall, payoffs to irrigation investments are, therefore, more limited where soil moisture capacity is higher. Irrigation potential is defined as the percentage of a district's area inside any type of irrigation command area, that is, the sum of proposed command area, command area under construction and already existing command area. This variable has been measured using the Irrigation Atlas of India. Planned command areas are a good indicator of the remaining potential for canal irrigation in India as they reflect long-range plans. Any area not yet included in these plans has virtually no potential. Flood potential is the proportion of the district liable to flooding. The number of cool months are those with mean temperatures less than 18 degrees centigrade. Wheat does not grow in areas without cool months and this variable proxies the ability to grow wheat.

4. ECONOMETRIC RESULTS

Table 4 shows the first stage credit equation that is used to predict credit supply in the second stage equations. It was estimated with the random effects technique.

The table shows that better agroclimate, as measured by a long rainy season, high irrigation potential and high soil moisture capacity, leads to higher credit use. Conversely, lending is lower in areas with high flood risk. As expected, areas with better

Table 4:

DETERMINANTS OF INSTITUTIONAL CREDIT ADVANCE TO RURAL SECTOR

Explanatory Variable	Institutional Credit Random effect	
Aggregate real crop (real) price (lagged) a/	-0.038	(-0.383)
Real price of fertilizer a/	-0.207	(-0.833)
Real urban wage a/	-0.168	(-1.159)
Rainfall x 10_3	-0.055	(0.637)
Roads a/	2.166	(5.181)*
Regulated markets a/	0.536	(3.598)*
Primary schools a/	0.986	(1.418)*
Rural electrification a/	-0.357	(-1.979)*
Canal irrigation a/	-0.189	(-0.987)
Commercial banks a/	0.801	(8.565)*
Cooperative banks a/	0.239	(1.904)*
Primary cooperative societies a/	-0.801	(-4.081)*
Land development banks a/	-0.287	(-1.853)*
Year	-64.962	(-4.276)*
Year x irrigation potential	0.471	(3.847)*
Year x excess rain months	-2.399	(-0.723)
Year x length of rainy season	5.760	(1.688)*
Year x soil moisture capacity	14.308	(4.339)*
Year x flood potential	-1.957	(-2.006)*
Year x number of cold months	1.434	(0.486)
F-statistic Hausman-Wu (Chi-square, 20 df. Number of observations	32.63 25.05 765	

Note: T-statistics are in parenthesis. Asterisk refers to a significant level of 10 percent or better.
a/ Coefficients are in elasticity form.

roads and market infrastructure also receive more credit while rural electrification appears to reduce credit availability. Credit expansion was particularly rapid in areas with rapid increase in the number of commercial banks and also expanded with the number of cooperative banks. Areas where the consolidation of primary cooperative credit societies reduced, the number of PACs received more credit, while increases in the number of land development banks have negative effect on credit use. The price variables have no significant effect on credit use and neither does rainfall received in the year of observation. Based on the estimates of Table 4, we predict the amount of credit supplied to each district by formal lending agencies each year.

Table 5 presents the estimates of the aggregate supply equation. The first column uses data from 21 years, covering both the 1960s and 1970s. The variable "commercial bank branches" is used as a farmer-exogenous variable to instrument credit supply. Complete credit data are only available for the 1970s. The equations in the second and third columns, therefore, used only data from nine years. In the second equation, the predicted total rural credit from Table 4 is used. In the third equation, we focus on cooperative agricultural credit and use predicted cooperative credit from an equation similar to that in Table 4. Cooperative credit includes credit from both PACs and land development banks.

The first supply equation with the longer time series was extensively discussed in Binswanger, Khandker and Rosenzweig (1987), who highlighted the strong positive effects

Table 5:

Effect of Credit and Commercial Banks on Agricultural Output

Explanatory Variable	Commercial Bank Branches (Fixed Effect)	Total Rural Credit (Random Effect)	Cooperative Agricultural Credit (Random Effect)
Commercial bank branches			
Institutional Credit (predicted) a/	0.020 (1.918)	0.027 (1.372)	0.063 (2.381)*
Aggregate real price index a/	0.130 (6.472)*	0.342 (1.251)	0.007 (0.011)
Real fertilizer price a/	-0.117 (2.316)*	0.094 (1.380)	0.120 (1.640)*
Real urban wage a/	0.053 (1.497	0.137 (3.547)*	0.154 (3.594)*
Real interest rate a/	-0.001 (-0.202)	na	na
Road a/	0.201 (6.549)*	-0.118 (-0.961)	-0.037 (-1.456)
Canal irrigation a/	0.026 (0.827)	-0.080 (-1.525)	-0.061 (-1.070)
Primary school a/	0.335 (4.322)*	0.269 (1.378)	-0.021 (-0.880)
Rural electrification a/	0.028 (1.603)	0.073 (1.532)	0.100 (1.778)*
Regulated market a/	0.084 (4.972)*	0.132 (3.277)*	0.046 (0.852)
Rainfall x 10^3	0.071 (3.458)*	0.000 (3.855)*	0.000 (2.848)*
Year	-0.026 (4.299)*	-0.041 (-2.618)*	-0.012 (-0.395)
Year x Cool months	0.006 (4.316)*	0.002 (0.847)	0.002 (0.442)
Year x length rainy season	-0.003 (-1.989)*	0.002 (0.527)	-0.001 (-0.174)

Table 5:

Effect of Credit and Commercial Banks on Agricultural Output (Continued)

Explanatory Variable	Commercial Bank Branches (Fixed Effect)	Total Rural Credit (Random Effect)	Cooperative Agricultural Credit (Random Effect)
Year x flood potential	-0.001 (-3.679)	-0.001 (-0.806)	0.000 (-0.130)
Year x irrigation potential	0.001 (12.057)	0.001 (5.638)*	0.001 (4.372)*
Year x soil moisture capacity	0.005 (3.791)*	0.007 (2.260)*	0.004 (0.673)
Year x excess rain months	-0.004 (-3.086)	-0.006 (-1.805)*	-0.011 (-2.466)*
F - Statistic	103.936	17.632	15.460
Hausman-Wu (Chi-Square, 18)	44.754	33.781	31.233
No. of observations	1.785	765	765

Notes: t-statistics are in parenthesis. Asterisk refers to significance level of 10 percent or better on a two tail test.

a/ Coefficients are in elasticity form.

of the infrastructure variables, roads, markets, primary schools, and perhaps electrification. Shortening the time series, and using 2SLS, leads to a loss in the precision of the estimates, with fewer variables being statistically significant. All three equations estimate a low short-run elasticity of aggregate output with respect to the output price which is consistent with the literature. They also show a high rainfall elasticity.

More importantly, the first and second equations show similar elasticity for the credit related variable: 0.20 for number of commercial banks and 0.027 for predicted total credit. The latter estimate is barely significant at the ten percent level in a one-tail test. The third equation shows the elasticity with respect to cooperative agricultural credit; at 0.063 it is substantially larger than the elasticities for total rural credit. This may be because cooperative credit is restricted to farmers and, therefore, has a more direct impact on agricultural output.

Annex 1, Tables 1 to 4 show the complete 2SLS equations for agricultural investments, fertilizer use, rural employment and real agricultural wage, using total predicted credit and predicted cooperative credit, respectively. A similar set of equations, using the number of commercial bank branches is reported and discussed in Binswanger, Khandker, and Rosenzweig, 1989. In Table 6 we then summarize the credit effects from all these equations. Each number in Table 6 is, therefore, the financial intermediary coefficient of a separate regression equation. The explanatory variable is given at the top while the dependent variable is on the left hand side.

Table 6:

IMPACT OF FINANCIAL SYSTEM ON AGRICULTURE AND THE RURAL ECONOMY
(independent variables)

Dependent variables	Predicted cooperative credit advanced	Number of commercial bank branches	Predicted Overall rural credit advanced
Aggregate crop output	0.63 (2.38)*	0.020 (1.92)*	0.027 (1.37)
Fertilizer demand	0.39 (4.55)*	0.25 (6.69)*	0.305 (6.67)*
Investment in tractors	n.a.	0.14 (1.31)	n.a. a/
Investment in pumps	.40 (3.59)*	0.38 (3.61)*	0.461 (3.63)*
Investment in draft animals	0.14 (0.62)*	0.71 (1.96)*	0.395 (1.56)
Investment in milk animals	0.58 (4.34)*	0.52 (2.63)*	0.763 (5.09)*
Investment in small stock	0.84 (3.60)*	0.16 (-0.42)	0.758 (5.09)*
Agricultural employment	-0.07 (2.51)*	-0.07 (-2.69)*	-0.050 (2.07)*
Rural nonagricultural employment	0.06 (1.48)	0.29 (10.94)*	0.242 (5.26)*
Rural wages	0.03 (1.34)	0.06 (2.01)*	0.061 (2.93)*

Note: T statistics are in parenthesis. Asterisk refers to significant level of 10 percent or better on two-tail test.

a/ This equation could not be estimated as multicollinearity left all coefficients nonsignificant.

In Table 6 we see that rural credit has a measurable positive effect on agricultural output. Cooperative credit advanced has an elasticity with respect to output of 0.063. This elasticity is fairly precisely estimated. It is larger than the elasticity of crop output with respect to predicted overall rural credit which is near 0.027, but not precisely estimated. The estimate for the impact of commercial bank branches on output is more precisely estimated at 0.020.

Fertilizer use has an elasticity of 0.39 with respect to cooperative credit, an elasticity of 0.31 with respect to overall rural credit, and an elasticity of 0.25 with respect to commercial bank branches. The impact of the credit variables on fertilizer use is thus between five to ten times as large as their impact on aggregate crop output.

The fertilizer demand effects can account for a major share of the output supply effect: suppose the elasticity of crop output with respect to fertilizer use is only ten percent, i.e., a ten percent increase in fertilizer use would lead to a one percent increase in aggregate crop output. The elasticity of fertilizer use with respect to credit is estimated between 0.25 and 0.39 depending on the variable used. Therefore, the elasticity of output with respect to credit through its impact on the use of fertilizer would be equal to 0.1 x 0.25 = 0.025 at the minimum or 0.1 x 0.39 = 0.039 at the maximum. This compares to the estimate of the elasticity of output with respect to credit between 0.020 to 0.064. Therefore, the increased fertilizer use could account for at least 2/3 of the entire output effect of additional credit, if not the entire effect.

What about the impact of credit on other investments? Commercial bank branches, overall rural credit expansion, and cooperative credit, increase the rate of investment in tractors, pumps, draft animals, milk animals and small stock, although not all coefficients are statistically significant. (The impacts on capital stocks will, of course, be less than the impact on the rate of investment, since investment is the addition to the stock).[8/] Thus, investments may not only have affected output, but may also substitute for labor.

While we cannot evaluate the output effect or employment effect of the investments, we have estimated the employment effect of the credit variables. Growth in commercial banks, overall credit and cooperative credit reduce agricultural employment with an elasticity of 0.07, 0.05 and 0.07, respectively. The estimates are very close to each other. The proportional labor displacement caused by credit expansion is as large or larger than the proportional increase in crop output.

To summarize, institutional growth and higher lending volumes lead to modest increases in aggregate crop output; sharp increases in the use of fertilizers and in investments in physical capital and, substantial reductions in agricultural employment. The expansion of credit, therefore, has led to the substitution of capital for agricultural labor.

8/ The elasticities of investments with respect to credit appear to be high. But these elasticities are not directly comparable to the fertilizer use elasticity, as investment should decline to zero once equilibrium capital stocks are reached. Investment is, therefore, much more variable than capital stock, and elasticities are higher.

Rural Nonfarm Growth and Rural Wages

In Table 2, we saw that more than half of the commercial bank credit outstanding in rural and semi-urban branches goes to sectors other than agriculture and food processing. Confining the investigation of the effects of the rural financial system to its effect on agriculture would be to ignore its potential positive effects on the rural nonfarm sector. Any positive effect on nonfarm output and employment could mitigate the negative effect on farm employment. Unfortunately, data on rural nonfarm output does not exist.

We are, therefore, using rural nonagricultural employment, which is available in the decennial censuses. In the census, both farm and nonfarm employment are measured by primary occupational status. Individuals are asked whether they worked in agriculture or nonagriculture for at least 183 days during the previous year. Random effects regression similar to the ones in Table 5 for crop output are run to explain the employment growth between the two population censuses of 1970 and 1980, in the sample of districts under investigation (for details see Khandker 1989). As rural wage data are also not available, data on agricultural wages published by the Ministry of Agriculture are used as a proxy . The wage rate for rural field workers is used.[9/]

The impacts on nonagricultural employment of commercial bank expansion and of overall rural credit are large, the estimated are close at 0.24 and 0.29. Not surprisingly,

9/ Where data for field workers was further disaggregated, the data for the ploughmen was used.

the impact of cooperative agricultural credit is much smaller, only 0.06, and not statistically significant.

Is it possible to say something about the effect of nonfarm output? The nonfarm sector borrows to finance material inputs and capital. If, as in agriculture, these inputs partly substitute for labor, the output effect of credit must exceed the employment effect. Therefore, the estimate of the nonfarm employment elasticity of credit must be a lower bound of its effect on nonfarm output, i.e. nonfarm output elasticities of rural credit should exceed 0.24.

The effect of commercial banks and overall rural credit on nonfarm output and employment thus has been large, so large indeed that agricultural wages have also risen. The wage effect of commercial banks and rural credit are small, but each elasticity of 0.06 is statistically significant. The wage elasticities are of the same absolute magnitude as the (negative) agricultural employment elasticities. Therefore, the expansion of the credit system must have left the agricultural wage bill unchanged. And it must have substantially increased the rural nonfarm wage bill.

5. REFLECTIONS ON BENEFITS AND COSTS OF SUBSIDIZED CREDIT

In this section, the econometric results are used to compare the value of extra agricultural output to the government costs of increasing the amount of subsidized loans

advanced to agriculture by ten percent from its level in the middle of the period of analysis. The four-year averages for 1975/76 to 1978/79 are used as base period amounts. Estimates of credit subsidies also refer to those four years.

Benefits

The value of extra-agricultural income associated with the extra credit is assumed to be the additional return to fixed factors in agriculture, that derives from the additional output. The returns to fixed factors is net national product in agriculture less the value of material inputs, less employee compensation. Using this definition for the calculation implicitly assumes that, when agricultural output expands, material inputs and hired labor are used in fixed proportion.[10/] Moreover, family labor, land and capital in agriculture is assumed immobile between sectors.

The coefficient estimate used for the analysis measures the impact of additional disbursements of rural credit on output of 17 crops. We want to include the remainder of agricultural output in the analysis. Therefore, we further assume that the elasticity of livestock output and of those crop outputs not included in the data is the same as that for the 17 crops that were included in the analysis.

10/ If additional credit induces farmers to increase the material intensity of production the assumption of fixed coefficients for purchased inputs would tend to bias benefits upwards as it would underestimate the marginal material cost of extra output.

What elasticity should be used to evaluate benefit cost ratios? The elasticity of aggregate crop output with respect to commercial bank branches of 0.020 best represents the impact of that system, while the elasticity with respect to cooperative credit of 0.063 best represents the impact of the cooperatives. In the middle of the period of investigation, the weight of the commercial banks in total agricultural credit advanced was less than 50 percent while it increased to slightly above 50 percent by the end of the period. Fifty percent weights for these two elasticities may therefore, be appropriate i.e., we may use an elasticity of 0.42.

Average net national product in agriculture for the years 1975/76 to 1978/79 was Rs 284,162 million. Material inputs were Rs 88,524 million, 31 percent of net domestic product. Employee compensation was Rs 64,917 million. Therefore, return to fixed factors was Rs 130,720 million. With an elasticity of 0.042, an extra ten percent disbursements of credit would yield the following extra agricultural income: 0.042 x 13,813.4 = Rs 580.1 million.

Government Costs

We now need to estimate the government cost of the subsidies. For this we try to make conservative assumptions. During the same years, total agricultural credit disbursements averaged Rs 20,550 million, of which Rs 13,684 million, or 66.6 percent were short-term loans. We assume the following costs for this credit to the government over and

above the interest payments of the agricultural producers. The assumption behind these cost estimates are further discussed in Annex 2.

1. Interest subsidy at three percent per year, that is, opportunity cost of capital is assumed to exceed agricultural interest rates by at least three percent. Those loans that are eventually repaid are assumed to be outstanding for an average of 2.61 years. This implies an interest subsidy over the entire life of the loan of 7.8 percent of the principal.

2. For every rupee of loans advanced, Rs 0.1 will eventually be lost to default. The cost of this to the government is ten percent of the principal.

3. A subsidy by the commercial banks and/or the government to the salary cost of operating the branches and/or credit societies. Assuming three persons per branch working on agricultural credit, one person per credit society and five persons per land development bank branch, each of them in the late 1970s costing a total of Rs 15,000 per year to employ (salary and benefits). And assuming about Rs 20,000 overhead personnel for the commercial banks, the cooperative banks and NABARD. The total would be 200,000 x 15,000 = Rs 3,000 million, or 14.5 percent per unit of credit advanced. We assume that government ultimately pays half of this cost, or 7 .2 percent of the principal advanced while the credit agencies are able to cover the other half of the cost.

Total cost to the government of advancing the loans = (1)+(2)+(3) = 7.8+10+7.2 = 25 percent of the principal over the lifetime of the loans. Since the loans are outstanding for an average of 2.61 years, the annual cost is 9.57 percent of the initial principal per year during which the loan is outstanding.

Stated otherwise, if agricultural credit rates were on average about 12.4 percent per year, the credit institutions would have had to charge 22 percent to break even, including all administrative costs and coverage of losses.

We, therefore, compute the costs of the extra credit of Rs 2,055 million as 0.25 x 2,055 = Rs 513.8 million. The extra agricultural income was estimated at RS 580.1 million, i.e., it exceeds the cost to the government by about 13 percent.

How sensitive is this result to the assumption made? The benefit cost ratio will be overestimated if (a) coefficients between output and working capital are not fixed but credit increases the capital intensity of production, as clearly indicated in the econometric results; (b) livestock output responds less to credit than crops; (c) if the government pays more than 50 percent of the salary cost of running the system or the salary costs were underestimated; (d) if more than ten percent of credit advanced becomes nonrecoverable; and (e) if interest subsidies exceed three percent per year.

It is not so easy to identify factors which could have led to the underestimation of the benefit-cost ratio. Of course, the underlying elasticity estimates have standard errors of about half the coefficient size. Given all these factors of uncertainty we can conclude that the government's costs of providing these credit subsidies have most likely been of the same order of magnitude as the benefits in terms of agricultural value added, but that the estimates allow no firm conclusion of whether agricultural income benefits have exceeded government costs of providing the credit or not.

Additional Private Costs

To generate the extra farm income using this extra credit, farmers also use family labor. For those family workers who are potentially mobile between sectors their cost has to be added to the cost of the government. It is not possible to divide family labor into mobile and immobile labor. However, family labor is a very large cost element, therefore any corresponding adjustment will tend to reduce extra agricultural income benefits to less than total private and government costs. An additional private cost element not yet counted is the annualized cost of the fixed capital investments (animals and machines) which are used to produce the extra output associated with the credit.[11/] It has not been possible to estimate the extra cost of these added inputs, since the corresponding capital prices are not available, nor the asset-specific depreciation rates. Finally, there are real transaction costs of the borrowers for obtaining the credit. (Note that bribes and other transfers from borrowers

11/ The cost of material inputs has already been subtracted.

to credit agency personnel are not a social cost, only a transfer). Little hard data exists on transactions costs in India. However, for other rural credit systems estimates of borrowers' transactions costs range from four percent in a program in Bolivia (Ladman, 1988) to over 30 percent in a program in Jamaica (Graham and Pollard, 1988). Partly offsetting these private costs are the incomplete loan recoveries. They are a benefit to the borrowers and a cost to the lenders (government). In the calculation of government costs, we assumed these losses to be ten percent of initial loan amounts. The transactions costs of borrowers in India may, therefore, be commensurate with the transfers they receive from not paying back loans, i.e., the two may cancel each other out in which case the cost to government would also be an estimate of the entire social cost.

To conclude, the agricultural income gains associated with agricultural credit have either been about equal or have fallen short of the government's costs of providing it. Agricultural benefits have not exceeded the social costs and may have fallen short of it. Substantial additional work would be required to firm up these tentative calculations.

6. SUMMARY AND CONCLUSIONS

India has systematically pursued a supply leading approach to increase agricultural credit. The objectives have been to replace moneylenders, relieve farmers of indebtedness and to achieve higher levels of agricultural credit, investment and agricultural output. India's success in replacing moneylenders has been outstanding: between 1951 and

1971 their share of rural credit appears to have dropped from over 80 percent to 36 percent. According to NSS data it may have dropped to as low as 16 percent by 1981, but that estimate is in dispute (Bell, 1990).

However, institutional credit is far from reaching all farmers. Only about a quarter of cultivators borrow and long-term loans are received by no more than two percent (Rath, 1987). The majority of small farmers have little access to credit and long-term credit is highly concentrated among large farmers.

Overall farm debt has probably not increased sharply in real terms as formal credit has primarily substituted for credit from other sources.[12/] Moreover, with the rapid growth of commercial banks during the 1970s, the overall institutional system in 1981 mobilized more deposits in rural areas than it lent to them. Of course, enhanced deposit services are a useful service for the rural population. Nevertheless, we must ask what has been the impact of large rural credit and enhanced financial services on agricultural investment, production and rural incomes. Our econometric results suggest that the rapid expansion of commercial banks in rural areas has had a substantially positive effect on rural nonfarm employment and output. The availability of better banking facilities appears to have overcome one of the obstacles of locating nonfarm activities in rural areas.

12/ The controversial results of the All-India Debt and Investment Survey of 1981/82 suggests that real indebtedness may even have declined.

In agriculture, the output and employment effect of expanded rural finance has been much smaller than in the nonfarm sector. The effect on crop output is not large, despite the fact that credit to agriculture has strongly increased fertilizer use and private investment in machines and livestock. High impact on inputs and modest impact on output, clearly mean that the additional capital investment has been more important in substituting for agricultural labor than in increasing crop output.

Nevertheless, the overall impact of rural credit and the expansion of the rural financial system on rural wages has been positive, as the creation of nonfarm employment has added more to total employment than has apparently been subtracted by the substitution of capital for labor in agriculture. And, therefore, wages have risen even for agricultural workers, albeit at a very modest rate.

The supply-led approach to agricultural credit, pursued over the last three decades, has clearly been beneficial to current borrowers and farm households formerly indebted to moneylenders. It has also spurred fertilizer use and investment in agriculture. But it has been less successful in generating viable institutions. It has failed to generate agricultural employment. The costs of the policy to the Government of India have been high as portfolio losses associated with poor repayment have ultimately to be borne by the government or one of its institutions. A comparison of the agricultural income benefits with the government cost of the extra agricultural credit suggests that the former manages to exceed the latter by, at best 13 percent. If the assumption on cost of supplying the credit and

on repayment rates underlying this calculation was over optimistic, both government cost and the social cost of providing the credit would have exceeded the agricultural income benefit.

The challenging question, therefore, is the following: The expansion of commercial banks to rural areas has had major payoffs in terms of nonfarm growth, employment and rural wages. Could these benefits have been achieved without imposing agricultural credit targets on the commercial banks and the cooperative credit sector? Or, did the commercial banks only expand because they are forced to lend to agriculture? We cannot answer these questions with the data at hand.

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Annex 1, Table 1:

RANDOM EFFECT OF INSTITUTIONAL CREDIT ON AGRICULTURAL INVESTMENT a/
(number of observations = 228)

	Investment in			
Explanatory variable	Draft animals (Random effect)	Milk animals (Random effect)	Small Stocks (Random effect)	Pumps (Random effect)
Institutional credit (predicted) b/	0.395 (1.558)	0.763 (5.091)*	0.758 (2.797)*	0.461 (3.633)*
Aggregate real output price index (lagged)	2.663 (3.548)*	0.254 (0.584)	1.690 (2.147)*	0.669 (1.857)*
Real price of fertilizer b/	-15.386 (-5.448)*	-12.641 (-7.693)*	-19.539 (-6.633)*	0.038 (0.028)
Real urban wage b/	-0.142 (0.132)	-1.156 (-1.855)*	-3.772 (-3.335)*	0.024 (0.046)
Roads b/	1.550 (1.714)*	-2.530 (-4.425)*	1.464 (1.391)	-0.408 (-0.879)
Canal irrigation b/	-0.718 (-1.233)	-0.010 (-0.027)	0.161 (0.228)	-0.174 (-0.570)
Primary schools b/	6.549 (3.846)*	-1.057 (-0.973)	0.031 (0.015)	-0.405 (0.472)
Electrification b/	0.155 (0.402)	0.605 (2.638)*	-1.099 (2.630)*	0.079 (0.416)
Regulated markets b/	0.100 (0.230)	0.150 (0.593)	0.565 (1.205)	0.053 (0.253)
Rainfall x 10^3	0.004 (0.757)	0.023 (2.708)*	-0.007 (-1.310)	0.001 (1.277)
Past stock	-0.236 (-15.076)*	-0.006 (-0.125)	-0.208 (-14.991)*	-0.094 (-9.332)*
Year	-0.655 (-0.712)	4.715 (3.345)*	1.457 (1.724)*	0.082 (0.736)

Annex 1, Table 1:

RANDOM EFFECT OF INSTITUTIONAL CREDIT ON AGRICULTURAL INVESTMENT a/ (number of observations = 228) (Continued)

	Investment in			
Explanatory variable	Draft animals (Random effect)	Milk animals (Random effect)	Small Stocks (Random effect)	Pumps (Random effect)
Year x cool months	0.146 (0.994)	-0.685 (-2.926)*	0.850 (6.192)*	0.074 (4.274)*
Year x rainy season	0.101 (0.538)	1.037 (3.604)*	0.050 (0.287)	-0.007 (-0.295)
Year x flood potential	0.015 (0.245)	0.071 (0.766)	0.172 (3.115)*	0.003 (0.356)
Year x irrigation potential	0.005 (0.634)	-0.006 (0.560)	-0.022 (-3.189)*	-0.001 (-1.255)
Year x soil moisture capacity	-0.072 (-0.381)	-0.995 (-3.468)*	-0.179 (-1.040)	-0.039 (-1.783)
Year x excess rain months	0.249 (1.528)	-0.804 (3.188)*	-0.132 (-0.873)	0.012 (0.631)
Constant	154.230 (2.021)*	-135.614 (-1.016)	170.9169 (1.993)*	-2.127 (-0.220)
F-statistic	16.417	26.404	16.258	6.201
Hausman-Wu (Chi-square, 18 df)	15.039	17.268	20.338	13.988

Note: T-statistics are in parenthesis. Asterisk refers to significant level of 10 percent or better on a two-tail test.

a/ A tractor equation could not be estimated with 2SLS squares

b/ Coefficients of these variables are in elasticity form.

Annex 1, Table 2:

EFFECT OF INSTITUTIONAL CREDIT ON FERTILIZER, FARM AND NONFARM EMPLOYMENT, AND AGRICULTURAL WAGE

Explanatory Variable	Fertilizer Consumption (Fixed effect)	Nonfarm Employment (Random Effect)	Farm Employment (Random Effect)	Agricultural Wage (Random Effect)
Institutional Credit (predicted) a/	0.305 (6.666)*	0.242 (5.257)*	-0.050 (-2.074)*	0.061 (2.928)*
Aggregate real output price index (lagged) a/	0.044 (0.835)	-0.011 (-0.147)	-0.006 (-0.153)	0.041 (1.671)*
*Real price of fertilizer a/	-0.506 (-3.938)*	0.069 (0.117)	0.231 (0.755)	0.042 (0.700)
Real urban wage a/	0.176 (2.356)*	0.050 (-0.225)	-0.288 (-2.506)*	0.384 (10.927)*
Regulated market a/	0.229 (2.723)*	-0.116 (-1.965)*	0.035 (1.141)	-0.076 (-2.077)*
Canal irrigation a/	0.222 (2.214)*	-0.030 (-0.333)	-0.140 (-2.961)*	-0.064 (-1.430)
Rural electrification a/	0.250 (2.717)*	0.150 (3.169)*	-0.038 (-1.547)	0.077 (1.805)*
Road length a/	-0.638 (-2.506)*	0.040 (0.213)	0.228 (2.312)*	-0.227 (-2.196)*
Primary school a/	0.570 (1.456)	-0.651 (-2.780)*	0.147 (1.205)	-0.196 (-1.192)
Annual rainfall x 10^3 a/	0.001 (0.692)	---	----	0.001 (2.605)*
Year	-1.337 (-1.753)*	10.070 (3.373)*	-0.785 (-0.330)	0.186 (12.387)*
Year x irrigation potential	(0.019) (3.004)*	-0.060 (-2.463)	0.066 (3.429)*	-0.000 (-0.460)
Year x excess rain months	-0.588 (-4.133)*	1.472 (2.751)*	-1.650 (-3.871)*	0.018 (1.197)
Year x soil moisture capacity	0.563 (4.087)*	-1.924 (-3.420)*	1.064 (2.376)*	-0.035 (-2.248)*
Year x length of rainy season	0.085 (0.553)	-0.990 (-1.566)	0.568 (1.127)*	-0.022 (-1.368)

Annex 1, Table 2:

EFFECT OF INSTITUTIONAL CREDIT ON FERTILIZERS, FARM NONFARM EMPLOYMENT, AND AGRICULTURAL WAGE (Continued)

Explanation Variable	Fertilizer Consumption (Fixed effect)	Nonfarm employment (Random Effect)	Farm Employment (Random Effect)	Agricultural wage (Random Effect)
Year x flood potential	-0.020 (0.464)	0.232 (1.436)	0.411 (3.200)*	-0.004 (0.907)
Year x number of cold months	0.388 (2.514)*	-0.384 (-0.754)	0.777 (-1.917)*	-0.022 (1.605)
F-statistic		23.472	11.075	18.511
Hausman-Wu (Chi-square)	60.206	15.508	19.074	15.070
Number of observations	35.882 738	170	170	765

Note: T-statistics are in parenthesis. Asterisk refers to significant level of 10 percent or better on a two tail test.

a/ Coefficients are in elasticity form.

Annex 1, Table 3:

EFFECT OF CO-OPERATIVE CREDIT ON AGRICULTURAL INVESTMENT a/

Explanatory variable	Investment in: Draft animals (Random effect)	Milk animals (Random effect)	Small Stocks (Random effect)	Pumps (Random effect
Co-operative credit (predicted) b/	0.135	0.583	0.842	0.396
	(0.621)	(4.339)*	(3.601)*	(3.589)*
Aggregate real output price index (lagged)	2.513	0.044	1.581	0.583
	(3.397)*	(0.098)	(2.034)*	(1.617)*
Real price of fertilizer b/	-15.679	-14.049	-21.318	-0.829
	(-5.503)*	(-8.157)*	(-7.068)*	(-0.593)
Real urban wage b/	-0.161	-1.476	-4.241	-0.184
	(-0.148)	(-2.262)*	(-3.719)*	(0.344)
Roads b/	-1.145	-2.161	0.294	-0.247
	(-1.342)	(-3.748)*	(1.424)	(-0.543)
Canal irrigation b/	-0.848	-0.096	0.131	-0.237
	(-1.438)	(-0.229)	(0.186)	(-0.746)
Primary schools b/	6.274	-2.765	-2.787	-1.587
	(3.360)*	(-2.131)*	(-1.252)	(-1.609)
Electrification b/	0.229	0.955	-0.529	0.328
	(0.559)	(3.659)*	(-1.163)	(1.546)
Regulated markets b/	0.072	-0.088	0.102	-0.128
	(0.158)	(-0.314)	(0.205)	(-0.568)
Rainfall x 10^3	0.045	0.279	-0.065	0.010
	(0.972)	(3.171)*	(-1.282)	(1.575)
Past stock	-0.239	0.029	-0.210	-0.093
	(-15.260)*	(0.614)	(-15.107)*	(-9.248)*
Year	-0.687	7.834	3.359	0.292
	(-0.585)	(4.079)*	(3.036)*	(1.981)*

Annex 1, Table 3:

EFFECT OF CO-OPERATIVE CREDIT ON AGRICULTURAL INVESTMENT a/ (Continued)

	Investment in			
Explanatory variable	Draft animals (Random effect)	Milk animals (Random effect)	Small Stocks (Random effect)	Pumps (Random effect)
Year x cool months	0.159 (1.038)	-0.896 (-3.518)*	0.756 (5.310)*	0.063 (3.465)*
Year x rainy season	0.154 (0.830)	1.096 (3.684)*	0.020 (0.118)	-0.005 (-0.243)
Year x flood potential	0.009 (0.140)	0.129 (1.316)	0.209 (3.678)*	0.006 (0.851)
Year x irrigation potential	0.008 (1.161)	-0.002 (-0.159)	-0.023 (-3.554)*	-0.001 (-1.102)
Year x soil moisture capacity	-0.085 (-0.342)	-1.762 (-4.426)*	-0.611 (-2.655)*	-0.090 (-3.018)*
Year x excess rain months	0.302 (1.884)*	-0.706 (-2.719)*	-0.121 (-0.820)	0.018 (0.932)
Constant	158.932 (1.744)*	-342.204 (-1.935)*	48.636 (0.487)	-15.702 (-1.306)
F-statistic		25.691	17.179	6.288
Hausman-Wu (Chi-square, 18 df)	16.622 14.074	19.748	21.291	15.868

Note: T-statistics are in parenthesis. Asterisk refers to significant level of 10 percent or better on a two-tail test.

a/ A tractor equation could not be estimated with 2SLS squares

b/ Coefficients of these variables are in elasticity form.

Annex 1, Table 4:

EFFECT OF CO-OPERATIVE CREDIT ON FERTILIZER, FARM AND NONFARM EMPLOYMENT, AND AGRICULTURAL WAGE

Explanation Variable	Fertilizer Consumption (Fixed effect)	Nonfarm employment (Random Effect)	Farm Employment (Random Effect)	Agricultural wage (Random Effect)
Institutional Co-operative Credit (predicted) a/	0.394 (4.554)*	0.056 (1.476)	-0.069 (-2.514)*	0.028 (1.343)
Aggregate real output price index (lagged) a/	-0.021 (-0.217)	0.000 (0.005)	-0.011 (-0.219)	0.033 (1.353)
Real price of fertilizer a/	-0.557 (-2.431)*	0.381 (0.675)	0.123 (0.317)	0.026 (0.424)
Real urban wage a/	0.215 (1.594)	-0.009 (-0.045)	-0.295 (-2.029)*	0.379 (10.751)*
Regulated market a/	-0.042 (-0.236)	-0.085 (-1.355)	0.077 (1.761)*	-0.064 (-1.513)
Canal irrigation a/	0.140 (0.789)	-0.101 (-1.272)	-0.148 (-2.483)*	-0.075 (-1.700)*
Rural electrification a/	0.484 (2.740)*	0.148 (2.821)*	-0.078 (-2.136)*	0.084 (1.834)*
Road length a/	-0.895 (-1.936)*	0.573 (3.522)*	0.277 (2.230)*	-0.140 (-1.362)
Primary school a/	-0.914 (-1.145)	-0.395 (-1.599)	0.330 (1.791)*	-0.183 (-1.326)
Annual rainfall x 10^3 a/	-0.043 (-0.246)	----	----	0.026 (2.559)*
Year	2.061 (1.169)	5.661 (1.525)	-5.897 (-1.483)	0.166 (1.708)*
Year x irrigation potential	0.014 (1.293)	-0.001 (-0.041)	0.080 (3.318)*	0.000 (0.465)
Year x excess rain months	-0.549 (-2.211)*	2.005 (3.887)*	-1.624 (-3.065)*	0.027 (1.860)*
Year x soil moisture capacity	-0.505 (-1.362)	-1.671 (-2.083)*	2.406 (-2.809)*	-0.038 (-1.816)*

Annex 1, Table 4:

EFFECT OF COOPERATION CREDIT ON FERTILIZER, FARM AND NONFARM EMPLOYMENT, AND AGRICULTURAL WAGE (Continued)

Explanation Variable	Fertilizer Consumption (Fixed effect)	Nonfarm employment (Random Effect)	Farm Employment (Random Effect)	Agricultural wage (Random Effect)
Year x length of rainy season	0.097 (0.357)	-0.707 (-1.162)	0.661 (1.038)	-0.013 (-0.822)
Year x flood potential	0.060 (0.716)	0.102 (1.528)	0.270 (1.528)	0.003 (0.568)
Year x number of cold months	0.172 (0.601)	0.102 (0.200)	-0.571 (-1.095)	-0.019 (-1.421)
F-statistic Hausman-Wu (CHi-square) Number of observations	62.963 31.605 738	17.972 8.867 170	11.390 18.477 170	13.207 12.743 765

Annex 2

ASSUMPTION OF BENEFIT-COST ANALYSIS

1. Interest subsidy. 3 percent a year outstanding

2. Average length of outstanding per loan that is eventually repaid: 2.61 years

   This calculation assumes that, as in 1981/82,

   - 2/3 of loans advanced are short term with 6 month maturity
   - 1/3 are medium term with 3 years maturity
   - 1/3 are long term with 7 years maturity.

   All loans have the same overdue and nonpayment profile, derived from the data from the primary agricultural credit societies,

   - 56 percent are repaid on time
   - 11 percent are repaid one year late
   - 11 percent are repaid two years late
   - 11 percent are repaid three years late
   - 10 percent are never repaid.

   Under the assumptions, short-term credit is outstanding for an average of 1.1 year, medium-term credit for 3.7 years, and long-term credit for 7.6 years.

3. This can be combined with an interest subsidy of 7.8 percent over the life of the loan, that is, 2.61 percent to 3 percent.

4. Loan losses are 10 percent of loans advanced.

   Between 1980/81 and 1986/87 the following were the average overdue ratios:

   42.7 for land development banks)
   46.5 for commercial banks) An average 44 percent
   42.0 for PACS)

   There are no changes in trends in overdues.

   For PACs, between 1979/80 and 1981/82 (the last date available), 23 percent of overdue loans were overdue for more than 3 years. We will use this as the minimum percentage of overdues that are nonrecoverable. While some of these amounts may be recovered at a future date, some of the loans that are overdue for up to 3 years will also ultimately become nonrecoverable. This is, therefore, a good estimate.

If 44 percent of loans are overdue and 23 percent of the overdue loans cannot be recovered, 10.12 percent of demand is nonrecoverable. This means that of all new loans, 10.12 percent will eventually be lost.

5. Subsidy to operational cost of bank branches and credit societies. Commercial bank branches and cooperative societies are not covering their costs of lending to agriculture, as their margins on funds advanced by NABARD are slim (perhaps 1.5 to 2 percent) and differences between their deposit rates and lending rates are perhaps 6 to 7 percent at the maximum. Costs of lending to agriculture exceed these margins. Even if we assume that fixed costs of branches can be charged to deposit mobilization, there would still be cross subsidy by the bank to the cost of advancing agricultural credit.

Annex 2 Table 1:

OTHER DATA USED IN THE ANALYSIS

Year	Net domestic product in agriculture	Value of material inputs	Employee compensation	Short-term loans advanced	Long-term loans advance
1975	258,524	78,392	52,658	11,308	5,129
1976	263,590	85,175	56,658	13,163	6,806
1977	303,974	92,861	72,768	13,993	6,806
1978	310,560	97,667	77,674	16,270	8,721
Average	284,162	88,524	64,917	13,684	6,866

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